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ABSTRACT

Canadian students on the verge of completing their secondary education were tested to determine their proficiency in solving consumer-related mathematics problems that might be frequently encountered in their post-secondary everyday life. Their proficiency was rated as very good in basic computation and use of tables; satisfactory in comparison pricing; weak in percentages; and very weak in calculation of gross pay using a time card, and reconciliation of checkbook and bank statement. Although these findings indicate greater proficiency than was reported by the National Assessment of Educational Progress in the United States in 1972-1973, and the Learning Assessment Program in Mathematics in British Columbia in 1977, the author indicates that a higher level of proficiency might have been expected when over 80% of the students surveyed had completed eleven years of mathematics instruction. Placing more emphasis on the teaching of personal finance skills is recommended. (Author/CTM)

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REPORT NO.78:20 - A MEASUREMENT OF THE BASIC CONSUMER-RELATED MATHEMATICAL COMPETENCY OF URBAN GRADE 12 STUDENTS

Dr. Shirley Wong

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GRANT NO.: DG-154

AUTHOR(S): Dr. Shirley M. Wong, Faculty of Education, University of British Columbia, Vancouver, B.C. V6T 1W5

PROJECT DIRECTOR: (if different from author)

PROJECT SITE OR SAMPLE: 298 students from the nine school districts found in Greater Vancouver

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A MEASUREMENT OF THE BASIC CONSUMER-RELATED MATHEMATICAL COMPETENCY OF URBAN GRADE 12 STUDENTS

by

Shirley M. Wong

A Research Report

submitted to

Educational Research Institute of British Columbia

June 15, 1978

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PROBLEM AND PURPOSE

The purpose of the study was to determine whether students who were on the verge of completing their secondary education had acquired proficiency in solving consumer-related mathematics problems frequently encountered in their post-secondary everyday life. In other words how well were students prepared to cope with certain areas of consumer mathematics at the end of the secondary program.

RELATED LITERATURE

A comprehesive national survey in mathematics was conducted by the National Assessment of Education Progress (NAEP) in th United States in 1972-3. Four broad areas of consumer mathematics were included: 1. money problems, 2. measurement, 3. graphs, 4. averages and percent. This survey covered selected items from areas 1 and 4.

B. C.'s Ministry of Education conducted the Learning Assessment Program in Mathematics in 1977. Six of the 72 questions are consumer-related and three of the six covered the same topics as this study.

PROCEDURE

A. Population and Sample

A sample of 298 subjects represented approximately 17,500 urban, graduating students from the nine school districts found in Greater Vancouver (see Appendix.) Sampling procedure consisted of selection of three school districts, two schools and three grade 12 English classes using a table of random numbers. Two alternates in each category were also selected.

Considerable difficulty was met in obtaining participation in the study for two reasons. The major one was that schools were reluctant to relinquish any further loss of class time in view of the time already taken by the provincial learning assessment programme and the forthcoming English competency test. The other was the negative reaction felt by school personnel towards another

U.B.C. school study that had been widely publicized.

The sample was generated by random selection with the following qualifications: one of the school districts was an alternate; one school was an alternate with one class in place of 3; and one school had only two English 12 classes which represented all grade 12 students. The sample is deemed representative of the described population as all subjects entering the sample were randomly selected and no segment of the population was denied entry into the sample.

B. Measuring Instruments

A researcher-composed test covered six areas - one in basic computation and five in consumer mathematics:

1. Basic whole number computation
2. Use of tables
3. Calculation of gross pay
4. Reconciliation of chequebook and bank statement
5. Price comparison
6. Percentages

The analysis of each question is described in the Treatment and Interpretation of Data section and a copy of the test is found in the Appendix.

C. Test Administration

Consent to conduct the study was obtained from district superintendents, principals, department heads, and teachers of the classes forming the sample.

A preliminary interview was held with teachers who

were to administer the test to explain the purpose, time requirements, and procedures. The test was shown to the teachers but the researcher retained possession of all tests until they were delivered to the schools a day before the test dates. The tests were written on February 14th or 15th, 1978 on whichever day the teacher first met the class. Completed tests were collected on the 16th. No problems regarding administration were reported. A copy of the instructions which accompanied the packages of tests is shown in the Appendix.

TREATMENT AND INTERPRETATION OF THE DATA

Competency was measured by determining the mean percentage of accuracy for each question. The data were interpreted by comparing results to the NEAP and LAP-Mathematics findings followed by assigning a ranking of competency. The ranking categories were established on the independent judgment of the researcher and the terms used were Very good, Good, Satisfactory, Weak, and Very Weak. This classification is recognized to be subjective and is based on a number of considerations:

1. Question difficulty
2. Frequency of recurrence of question content in everyday life
3. Impact of lack of knowledge on the efficient management of one's personal finance

A. Basic Whole Number Computation

Table I - Basic Whole Number Computation

	Mean % Accuracy	NEAP - age 17
1. Addition 84 + 27	97	97
2. Subtraction 47 - 36	99	92
3. Multiplication 82 x 3	98	88
4. Division 6 / $\overline{582}$	91	93

The level of performance is rated Very good and indicates subjects possess basic computation skills.

B. Use of Tables

Subjects were given a page from the tax tables that accompany the annual income tax report and asked to write the federal tax and the provincial tax payable for the given taxable income amount.

Table 2 - Use of Tables

	Mean % Accuracy	NEAP Adult	BCLAPM
A. Federal Tax Payable	93		
B. Provincial Tax Payable	92	55%*	69%**
C. Do not know	1		

*The American tax tables are different in format and involve selecting the tax payable on the basis of the number of dependents.

**The provincial assessment required respondents to add the federal and provincial taxes payable and then select the correct answer from five alternatives. The level of performance was judged marginally satisfactory by the assess-

ment panel, but the performance may have been affected by the need for the subjects to add to obtain the correct answer.

The level of performance is judged highly satisfactory. The higher level may have been caused by the fact that the population is an urban group where many subjects have part time employment. Hence many may have experience in using these tables in completing their income tax reports.

C. Calculation of Gross Pay

A weekly payroll time card with starting and finishing times was provided along with the regular and overtime rates. The conditions for receiving overtime and deduction for a late penalty were supplied as explanatory statements. Subjects had to calculate daily hours, and make one deduction for lateness.

Table 3 - Calculation of Gross Pay

		Mean% Accuracy	NEAP%
a)	Calculation of daily hours worked	63	
	Monday	65	
	Tuesday	63	
	Wednesday	34	
	Thursday	62	
	Friday	60	
	Mean of Means - Daily Hours	57	
	Mean of Means - Excluding Wednesday	63	
b)	Total Hours	39	
c)	Total earnings before deduction for late penalty	35	
d)	Late penalty deduction	29	
e)	Gross earnings	12	31

Subject competency for this question is judged very weak.

Standard procedures are used in calculating pay regardless of type of method used and information about exceptions determined by salary contracts or company policy was and is provided by explanatory notes.

Evidence that students lack knowledge about payroll procedures is shown by the way hours worked and overtime were handled. Sixty-one percent did not know that in calculating the hours worked in a day, employees are not paid for the extra minutes shown on the cards in punching in and out. They also did not know that overtime is not paid unless time punches are shown in the overtime columns. Although time card formats differ, users of a time card should be able to read the data regardless of arrangement used.

D. Bank Reconciliation

Subjects were given three items:

1. A page from a cheque register showing entries for the month of May. A Subtraction error of ten cents was included in the balance of the first entry of May 15th, and all subsequent balances retained this difference. One cheque was outstanding at the end of the period and a deposit amount was $1.00 less than the figure shown in the bank statement.

2. A package of cancelled cheques using the bank

statement as a cover following the format used by local banks in sending these items to account holders. A service charge was included in the bank statement.

3. A solution form where the calculations for reconciliation between the closing balances of the bank statement and cheque register could be made. There were three conciliation items in the question and the preferred method of handling the item is described first:

A. The $1 difference in the deposit of May 15 could be added to the cheque register balance or subtracted from the bank statement balance.

B. The 10¢ difference in the cheque register balance following cheque No. 3 could be subtracted from the cheque register balance or added to the bank statement balance.

C. The service charge item could be subtracted from the cheque register balance or added to the bank statement.

Either method was accepted and the adjusted balances for the cheque register and the bank balances were correct so long as they were identical.

Table 4 - Bank Reconciliation

	Mean% Accuracy	NEAP
A. Identification of Bank Statement Balance	60	
B. Adjustment for outstanding cheques	14	
C. Calculation of Adjusted Bank Statement Balance	12	

D.	Identification of cheque register balance	43	
E.	Adjustment for error in deposit and related balance	10	
F.	Adjustment for service charge	17	
G.	Calculation of adjusted cheque register balance	10	1
Subject Background Information			
	Have a bank account	29	16
	Reconciliation knowledge	27	
	Reconciliation experience	22	9

Subject competency is rated as very weak with only 10% able to reconcile the two balances correctly although 27% believed they knew the procedure and 22% had experience. While performance is much higher than the NEAP finding, the result is alarming in view of the fact that reconciliation is usually performed monthly if one wishes to keep track of one's funds accurately.

Twenty-seven percent completed the question with identical but incorrect balances which indicates these knew the purpose of the procedure.

One reason for the low level of proficiency may have been caused by the fact that the problem was presented in the format encountered in reality and not in the narrative form found in textbooks. The narrative form does not provide student practice in the operations of sorting statement enclosures and identifying reconciliation items.

E. Price Comparison

The question on pricing provided 5 alternatives

showing four different quantities involving pounds and ounces that could be purchased for different amounts. The subjects were asked to find the alternative that offered the lowest cost. Two of the alternatives involved larger quantities than the correct answer and one a smaller quantity.

Table 5 - Price Comparison

		Mean% Accuracy	NEAP	B.C. LAPM
A.	10 ounces for 40 cents	6	10	
B.	1 pound 6 ounces for 99 cents	5	8	
C.	1 pound for 48 cents	79	34	64%
D.	2 pounds for $1.52	6	46	
E.	Do not know or did not answer	4	3	

Performance on price comparison is rated satisfactory.

F. Percentages

The first of two questions was finding the percentage of a number, given the number and the percentage amount.

6.A How much sales tax must be paid on a television set selling for $675 if the tax is 7%?

The second was finding the number, given the percentage figure and the percentage amount.

6.B A salesman receives 20% of his sales as his wages. How much did he sell on one day if he earned $17.00?

Table 6 - Percentages

	Mean% Accuracy	NEAP	B.C. LAPM
Percentage of a number	70.47	37%	62%
Calculating the no. given %	60.40	37%	

The performance on percentages is judged weak.

The mean percentage accuracy figures on this study are higher in all categories than findings of NEAP and the provincial LAP - Mathematics. This may be explained by the relatively homogeneous population used in this study as compared to the other two. Boundary lines between school districts are not divisive and geographic proximity facilitate contact and communication between educators.

Table 7 - Ages of Subjects

Age	Frequency	Percentage		B.C. LAPM	
15	----	----	94%	.1	93%
16	17	5.7		1.8	
17	214	72		60.4	
18	51	17		30.8	
19	9	3		4.5	
20	1	.33		1.1	
21	1	.33		.2	
No response	5	1.6		.6	

94% of the subjects are aged 16 - 18 as compared to 93% in the B. C. LAPM.

Table 8 - Sex of Subjects

Sex	Frequency	Percentage
Male	155	52
Female	143	48

Table 9 - Last Mathematics Course Completed Successfully

	Frequency	Percentage	
Mathematics 8	1	.3	
Mathematics 9	4	1.3	
Mathematics 10	46	15.4	
Mathematics 11	189	63.4	
Mathematics 12	33	11	
General Mathematics 10	6	2	
General Mathematics 11	11	3.7	
Terminal Mathematics 11	2	.7	
Other	4	1.3	
No response	2	.7	
			B.C. LAPM
Math courses numbered 10	52	18.2	15.1
Math courses numbered 11	200	70.1	45.8
Math courses numbered 12	33	11.6	37

82% had taken more than the minimum programme requirements in Mathematics - Math 10 which is similar to the provincial survey.

SUMMARY

A study was conducted to determine the level of proficiency in basic computation and 5 areas of consumer mathematics of grade 12 students just prior to graduation. The findings would indicate a graduate's ability to handle frequently recurring personal finance problems at the end of the secondary programme. The level of performance was rated using a 5-point scale with the terms: Very good, Good, Satisfactory, Weak, and Very weak.

Table 10 - Summary of Performance

		Mean% Accuracy	Proficiency Rating
I.	Basic Computation (+-x÷)	96	Very Good
II.	Use of Tables	92	Very Good
III.	Calculation of Gross Pay using a Time Card	12	Very Weak
IV.	Reconciliation of Cheque Register and Bank Statement	11	Very Weak

V.	Comparison Pricing	79	Satisfactory
VI.	Percentages		
	Percentage of a number	70	Weak
	Number of a given percent	60	Weak

CONCLUSION AND RECOMMENDATIONS

Excluding the item on basic computations graduating secondary students could handle only one area of the five consumer topics examined at a high level of proficiency. As the study was conducted during the last term of the school year the findings indicate that although more than 80% had 11 years of study in Mathematics a substantial majority of secondary students have not acquired basic competency in the topics examined.

Although findings show a higher level of competency than data reported by NEAP and LAPM the levels established indicate that secondary graduates will not be able to handle the areas of personal finances examined at a proficiency level that might be expected in relation to number of years spent in learning Mathematics. The importance and need for development of basic competency within the secondary programme are obvious and was recognized by recommendations 5 - 8 of the LAPM report.

RECOMMENDATIONS

1. That the importance and need for the teaching of consumer mathematics be brought to the attention of all teachers of Mathematics and of related subject fields such as

Business Education and Home Economics.

2. That a provincial curriculum in consumer mathematics be organized with input from representatives from subject fields presently teaching consumer mathematics by:

A. Identifying all topics presently taught irrespective of subject area.

B. Determining basic competencies required by all students and others where skills may developed to higher levels. A ranking of importance and suggested teaching sequence of selected topics would be useful to teachers presently teaching consumer mathematics.

C. Suggesting appropriate courses and grade levels for different topics. The above establishes the what, when, and where questions relating to consumer mathematics in the provincial secondary curriculum.

3. That the consumer mathematics topics presently found in "Goals Of The Core Curriculum" be examined and judged as to whether basic competencies have been included.

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British Columbia, Minister of Education. What Should Our Children Be Learning? Victoria, Queen's Printer, 1976.

National Assessment Of Education Progress. Consumer Mathematics: Selected Results from the First National Assessment Of Mathematics. Report 04-MA-02, 1974.

NEAP - Math Fundamentals: Selected Results from the First National Assessment of Mathematics. Report 04-MA-01, 1974.

Robitaille, D. F. and J. M. Sherrill - The B. C. Mathematics Assessment Report No. 1. Victoria, Ministry of Education Learning Assessment Branch, 1977.

APPENDIX

Population	Grade 11 Enrollment 1976 - 77
Vancouver	5,539
Burnaby	2,101
North Vancouver	1,908
West Vancouver	723
Richmond	1,582
Coquitlam	1,841
Surrey	2,137
Delta	1,318
New Westminister	436
	17,585

Province of British Columbia, Ministry of Education, Report On Education 1976 - 77, Victoria, Queen's Printer, 1978.

TEST ADMINISTRATION DIRECTIONS

On February 14th or 15th, whichever is the first day the class meets, please distribute the test at the beginning of the period. Announce to the class:

1. Test results have no bearing on their school grades. Data collected will be used for research purposes only.
   A mathematics test is being administered to English classes because this is the only course in which all grade 12 students enrol.
2. There is no time limit and questions may be answered in any order. Answers may be changed if needed. Use pen or pencil or any writing instrument.
3. Question 4 is to be answered on the solution form and requires the use of the enclosed bundle of cheques and bank statement.
4. When all questions have been completed, (including the questionnaire) papers should be turned in to the instructor. They may do their own work or follow whatever directions you wish to give them.

Please do not answer any questions about the test, but ask them to follow directions to the best of their ability.

After the test, please place them in the envelope and leave them for me in the office. I will collect them on February 16 or 17.

Please complete the following:

Total number of students in class _____

Total number writing test _____

If you would like a copy of the research report, please check the appropriate line: Yes _____ No _____. A copy will be sent to the principal.

Your assistance in the study is greatly appreciated. If we can be of service to you in any way, just call at any time.

Thanks,

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